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~~—————~~ ~~CENTRIFUGE~~

BACKGROUND AND SUMMARY

[0001] The ~~invention~~ present disclosure relates to a centrifuge with a rotatable centrifugal drum having a stack of discs.

[0002] Separators of this type are known in many different embodiments, for example, from German Patent Document DE 200 10 743 U1.

[0003] ~~It is an object of the invention to improve~~ The present disclosure relates to an improvement on this state of the art such that separators are created which have at least partially improved characteristics and ~~preferably~~ new usage possibilities.

[0004] ~~The invention achieves this task by means of the object of Claim 1 and creates~~ present disclosure relates to a new type of centrifuge which has many different advantages in comparison with the state of the art.

[0005] ~~According to Claim 1, the~~ The present disclosure relates to a centrifuge has having at least two centrifugal drums which can respectively be rotated about two axes of rotation, ~~in each case only one~~. One of the axes of rotation ~~extending~~ extends through the center of gravity of the centrifugal drums such that ~~one of the axes~~ axis of rotation is ~~in each case situated inside each of the at least one or more centrifugal~~ two drum(s) and the. An additional axis of rotation is situated outside the centrifugal drum(s), the drums. The two axes of rotation extending through the center of gravity ~~preferably being~~ may be aligned or may be parallel to one another —particularly situated in a plane, and one. A disc stack respectively being inserted is in each of the drums.

[0006] ~~This surprising idea of a "separator"~~ A separator or centrifuge with several at least two drums which each rotate about two axes of rotation and which each have a stack of

discs[[,]] results in new effects in the interior of the centrifugal drums which can be advantageously utilized, for example, for optimizing the solids discharge.

[0007] From the state of the art, filter centrifuges are known, for example, which have two filter drums (German Patent Document DE 3131329 A1).

[0008] German Patent Document DE 3 092 579 also shows an evacuating system for open drums which can be rotated about an axis of symmetry and, during the evacuation, are tilted about a second axis extending through the drum.

[0009] German Patent Document DE 1 432 853 OS shows a method and a device for separating substances by gyrofugation, ~~in the~~. In such a case of which one drum is rotated about its axis of symmetry and is moved about another axis on a circular ring, which axis is inclined by approximately 45° with respect to the axis of symmetry.

[00010] Concerning the state of the art, German Patent Document DE 40 13 388 A1 and Belgian Patent Document BE 703747 are also cited which are more remote.

[00011] However, separators with more than one drum, ~~which with each have one of the drum having a disc stacks stack and the drums which can be rotated being rotatable~~ about more than one axis of rotation are not known to be disclosed or suggested in the state of the art.

[00012] ~~Advantageous further developments of the invention are indicated in the subclaims.~~

~~13]~~[00012] ~~Since the centrifuge has two or even more~~ According to the present disclosure, a centrifuge includes at least two centrifugal drums, in which case again preferably one. One of the axes of rotation is situated inside the at least one or more two centrifugal drums, and the other axis of rotation is preferably situated outside the centrifugal drums[[,]]. Thus, a centrifuge is obtained which can more easily be balanced than a centrifuge with only one centrifugal drum, which is necessary because the additional axis of rotation of the centrifugal drum is situated outside the centrifugal drum.

~~41~~[00013] ~~It~~ The present disclosure can be implemented in a compact and uncomplicated manner such that the first axes of rotation of the drums are each situated inside the drums and are congruent with an axis of symmetry of the drums, ~~in which case the~~. The second ~~axes~~ axis of rotation perpendicularly ~~cross~~ crosses the first axes of rotation. This arrangement can be implemented, for example, by a dumbbell-type distribution of the drums, the axis of symmetry of the drums in each case representing the first axis of rotation and the two drums being rotated in a dumbbell-type manner about the second axis of rotation. In this case, the solids are transported to the outside ~~in a simple manner~~ as a result of the rotation of the two drums about the joint second axis of rotation, without requiring auxiliary devices for this purpose. ~~In contrast, the~~ The disc stacks have an ~~advantageously~~ additional clarifying effect because they rotate about the first axis of rotation. As a result of the rotation about the second axis outside the disc stack, which is superposed on the rotational speed of the first axis, ~~advantageous~~ flow behaviors are also obtained which differ from those of the state of the art.

~~45~~[00014] ~~Preferably the~~ The at least two centrifugal drums have a double-conical construction, including two mutually oppositely oriented conical sections each being constructed at ~~the~~ a respective end area, which of the drum. One such end area is ~~inside~~ relative located adjacent to the second axis of rotation~~[[,]]~~ and at the other such end area, ~~which is located and distanced further away~~ outside relative to the second axis of rotation, of the centrifugal drums. ~~In this case, it is advantageous for the~~ The two conical sections of each centrifugal drum ~~to be~~ are mutually connected by ~~way of~~ cylindrical sections.

~~46~~[00015] ~~Furthermore, particularly preferably one of the~~ A disc stacks stack with conical discs and ~~preferably~~ rising ducts is ~~in each case~~ arranged concentrically with respect to the inflow pipe in the ~~two~~ centrifugal drums. Solids from the ~~fed~~ feed or centrifugal material are separated in the disc stack and collected in the solids space (cylindrical) of the centrifugal drum. As a result of the rotation about the second axis A2, the solids are then

transported to the outside. ~~Particularly as~~ As a result of this construction, it becomes possible to convey the solids by ~~means of the~~ rotation of the ~~two~~ drums about the joint second axis of rotation completely automatically to the outside. A use of the system is conceivable for the purpose of clarification (solid/liquid) and/or of separation (liquid/liquid). As a result of the rotation about the first axis ~~respectively~~, the effect of the disc stacks is the same as in a normal separator. However the disc stacks can also have discs at the top. The rotational speed at the first axis corresponds to that of a separator.

17][00016] Since it becomes possible to transport the solids without additional mechanisms out of the drum, in comparison to decanters, this means that neither a planetary gear nor a screw are to be provided for discharging the solids. This also eliminates wear.

18][00017] In addition, because of the disc stack in the drums, an almost arbitrary clarification surface can be implemented. Mechanical limits as a result of natural frequencies can largely be avoided. It also becomes possible to mount self-cleaning sieve inserts. The energy requirement is relatively low because the solids outlet is situated in the center of the axis of rotation. By ~~means of the~~ an open inlet with centrifugal support, overflowing can be avoided. However, not only open but also closed systems, such as centripetal pumps or the like, are conceivable.

19][00018] In comparison to known separators, it is ~~advantageous that~~ no hydraulic drum system has to be provided for the evacuation. Also, the clogging of nozzles can be avoided because the nozzle diameter can be large in comparison to systems with many small nozzles, and the energy requirement for the solids discharge in the center of the main axis of rotation is low. Under certain circumstances, backwards-oriented nozzles are even conceivable if they do not also rotate about the first axis ~~[[{]].~~ This can be implemented, for example, by ~~means of floating ring seals) and if.~~ If the nozzles are arranged on a machine frame which rotates only about the second axis of rotation, ~~which~~ this again lowers energy requirements.

~~42~~[00019] _____ However, it should also be noted that it is conceivable to connect the two centrifugal drums behind one another ~~[[{]}]~~with respect to the flow path of the centrifugal material) ~~and to~~. And, for example, it is possible to use one of the first centrifugal drum drums for a preclarification and ~~the additional~~another centrifugal drum for the fine clarification which follows.

~~24~~[00020] _____ In the following, ~~the invention will be described in detail by means of an embodiment with reference to the drawing.~~ Other aspects of the present disclosure will become apparent from the following descriptions when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

~~22~~[00021] _____ Figure 1 is a sectional view of an embodiment of a centrifuge, according to the invention; ~~and present disclosure.~~

~~23~~[00022] _____ Figure 2 is a top view of the embodiment of Figure 1.

DETAILED DESCRIPTION

~~24~~[00023] _____ Figure 1 illustrates a centrifuge 1 having two centrifugal drums 2, 3 which are each rotatable about a first axis of rotation A1; ~~here, the,~~ shown as a horizontal axis of rotation.

~~25~~[00024] _____ The first axes of rotation A1 extend through the centrifugal drums 2, 3, in each case as axes of symmetry in their center of gravity and are aligned here with one another. The centrifugal drums 2, 3 are arranged opposite one another. However, the first axes of rotation A1 do not have to be mutually aligned. They can also have a different mutual orientation, preferably a parallel mutual alignment (not shown).

~~26~~[00025] _____ Furthermore, the centrifugal drums 2, 3 can each also be rotated about a second axis of rotation A2, which here is shown situated outside the centrifugal drums 2, 3. ~~Here,~~ The two centrifugal drums 2, 3 are rotated jointly "as a whole" about the second axis of rotation A2 situated outside the centrifugal ~~drum drums 2, 3~~—preferably. The second axis

of rotation A2 is in the joint center of gravity of the centrifugal drums 2, 3, which second axis of rotation A2 is situated perpendicular to the first axis of rotation A1 and crosses the latter.

43][00026] Since, in each case the embodiment shown, the first axes of rotation A1 are mutually aligned, and the second axis of rotation A2 is the same for both centrifugal drums 2, 3, the construction is simple and clear. Thus, a single driving device 20 is sufficient for the rotation of both centrifugal drums 2, 3 about the second axis of rotation A2.

28][00027] The centrifugal drums 2, 3 have a double-conical construction, including two mutually oppositely oriented inner and outer conical sections 4, 5, respectively. Inner conical section 4 each being is constructed at the end area, which area 26 and outer conical section 5 is constructed at end area 28. End area 26 is located adjacent is inside relative to the second axis of rotation A2, and at the end area, which 28 is outside located and distanced further away relative to the second axis of rotation A2 of the centrifugal drums and are in each case. The conical sections 4, 5 are mutually connected by way of central cylindrical sections 6. In the area of sections 4, 5, 6, the centrifugal drums 2, 3 have or comprise a continuous basket shell 24.

29][00028] At the outside ends end areas 28 of the outer conical sections 5, discharge openings 7 (nozzles) or nozzles are constructed, particularly for a solids phase and are oriented concentrically to the first axis of rotation A1. Relative to the first axis of rotation A1, the outer conical sections 5 are each preferably conically at an acute taper angle α (see Figure 1), the. The angle of taper α , with respect to the first axis of rotation amounting A1, amounts to 60° and or less, so that wear effects as a result of solids exiting from the nozzles 7 on the drum basket shell 24 are largely avoided. This angle α is selected such that the solids can advantageously slide off on this angle α .

~~44~~[00029] In the direction of the second axis of rotation A2, the inner conical sections 4 are followed by cylindrical attachments 8 which are rotatably disposed by ~~means of bearing systems 9, particularly for example, by means of suitable ball bearings 9,~~ in carrier elements 10~~[[,]]~~ which absorb axial and radial forces. It is also conceivable to provide additional bearing systems (not shown ~~here~~) in the an outer area of the centrifugal drums, ~~[[,]]~~for example, following the conical areas 5 on cylindrical attachments or the like (not shown ~~here~~)).

~~34~~[00030] One A centric feeding pipe 11 ~~respectively for the feeding~~ centrifugal material extends through the cylindrical attachments 8 and, for example, discharge ducts 12 arranged concentrically and/or parallel to ~~these pipes~~ pipe 11, for discharging a lighter phase, such as a liquid phase, ~~which ducts.~~ Ducts 12 may be connected toward the interior, ~~[[,]]~~ with respect to the second axis of rotation A2, ~~[[,]]~~ with additional inlet and discharge pipes (not shown ~~here~~) ~~[[,]]~~ which may go through the second axis of rotation A2[[,]]. The function of the feeding pipe 11 and the discharge ducts 12 can also be reversed, ~~[[,]]~~ with a corresponding modification of ~~the connections[[,]]~~. It is also conceivable to connect the two centrifugal drums 2, 3 fluidically behind one another.

~~32~~[00031] Toward the an interior of the arrangement of drum 2, 3, pulleys 13 are placed on the cylindrical attachments 8, which pulleys 13 are connected by ~~way of driving belts 14~~ with output shafts 15 of first driving devices 16, ~~particularly.~~ Driving devices 16 may be electric motors or hydraulic motors, which ~~are preferably~~ may be arranged parallel to the centrifugal drums 2, 3 on opposite sides of the centrifugal drums 2, 3 in order to implement an arrangement which is as free of imbalances as possible. Instead of a belt drive (~~for example, with 14, such as~~ flat belts, V-belts or toothed belts[[,]]), chain drives or direct-acting transmissions, such as toothed gearings, or the like, are conceivable.

~~33~~[00032] The two driving devices 16 as well as the carrier elements 10, which carry the centrifugal drums 2, 3, are arranged on a rotatable carrier-type ring 17, through whose

center the second axis of rotation A2 extends, ~~the~~. The centrifugal drums 2, 3 being are arranged above ring 17 and the first driving devices 16 being are situated below the ring 17. In addition, it is conceivable to arrange the centrifugal drums 2, 3 between an upper and a lower ring (not shown ~~here~~) or to arrange the driving devices also above the ring 17 (~~here also not shown.~~) Finally, ~~the~~The two centrifugal drums 2, 3 may also have a joint driving device 16 for driving the centrifugal drums 2, 3 about the first axis of rotation A1; ~~for~~. For example, a driving motor with two pulleys on a joint output shaft or the like (not shown).

34][00033] ~~By means use~~ of bearings 18, the horizontally aligned ring 17 is rotatably disposed on a base structure 19 and can be rotated by ~~means of~~ a second driving device 20 on the base structure 19. The bearing 18 absorbs ~~the~~ axial as well as ~~the~~ radial forces and can also be implemented in a different fashion.

35][00034] ~~One A~~ disc stack 21 ~~respectively~~ having conical discs is arranged concentrically with respect to the feeding pipe ~~10-11~~ in the two centrifugal drums 2, 3, which disc stack 21 can be provided with rising ducts 22 and can have a construction analogous to ~~the~~ disc stacks of separators.

36][00035] ~~During the an~~ operation, the two centrifugal drums 2, 3 rotate at a ~~higher~~ relatively high first rotational speed about the first axis of rotation A1, as compared to a rotational speed about the second axis of rotation A2. In this manner, a circumferential speed about the first axis of rotation A1 at ~~the an~~ outer drum diameter can be reached, which is known from decanters or, under certain circumstances, even from separators~~[[;]]~~. ~~for~~ For example, such a first rotational speed may be a circumferential speed of more than 80 m/sec. Whereas, the two centrifugal drums 2,3 ~~preferably~~ rotate about the second axis of rotation A2 at a relatively lower circumferential speed, such as at [[(]] a subcritical operation is ~~preferred~~ speed. The term "subcritical operation" indicates a rotational speed below the first resonance frequency of the separator.

37][00036] Centrifugal material in each case is fed through the feeding pipe 11 and enters into the centrifugal drums 2, 3, where liquids of different densities collect on different radii and are discharged through one or more discharge pipes or centripetal pumps, or the like.

According to Figure 1, only one liquid phase is discharged in each centrifugal drum 2, 3.

38][00037] The solid phases collect ~~in each case on the~~ an inner circumference of the centrifugal drums 2, 3, and, as a result of the rotation of the centrifugal drums 2, 3 about the second axis of rotation A2, ~~move toward the outside in~~ away from the latter, where they move in toward outer conical sections 5 to the discharge openings 7~~[[;]]~~. The solid phases move out of the centrifugal drums 2, 3 and are collected in a manner (not shown) here, for example, in an outer ring-type collecting device or the like (not shown).

39][00038] It is noted here that ~~it is a special advantage that~~ an almost "automatic" solids discharge is implemented through the discharge opening 7 in the outer conical sections 5, without ~~the~~ a requirement to provide auxiliary devices for the solids discharge, such as a screw, in the ~~drum~~ drums 2, 3. In contrast to separator drums, ~~the~~ a clogging of the nozzles can also be avoided. Although additional centrifugal forces may act upon the ~~system here~~ centrifuge disclosed herein, by ~~means of~~ a suitable compensation and a suitable distribution of ~~the masses, [[-]]~~ particularly by a suitable arrangement of the driving motors and by mass-balancing weights (not shown)~~[[-]]~~, these centrifugal forces can be kept within comprehensible limits.

40][00039] As a result of ~~the fact that several~~ providing at least two centrifugal drums 2, 3 ~~are provided~~, the capacity of each centrifuge is relatively large. It is even conceivable to arrange, instead of the two centrifuges shown herein, also three, four or more centrifuges evenly distributed around the second axis of rotation A2 on the circumference.

[00040] Although the present disclosure has been described and illustrated in detail, it is to be clearly understood that this is done by way of illustration and example only and is not to be taken by way of limitation. The scope of the present disclosure is to be limited only

by the terms of the appended claims.

Reference Symbols

Centrifuge	1
centrifugal drums	2,3
conical sections	4, 5
cylindrical sections	6
discharge openings	7
cylindrical attachments	8
bearing	9
carrier elements	10
feeding pipe	11
discharge ducts	12
pulleys	13
driving belt	14
output shafts	15
1st driving device	16
ring	17
bearing	18
base structure	19
2nd driving device	20
disc	21
rising ducts	22